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ABSTRACT

This environmental unit is one of a series designed for integration within the existing curriculum. The unit is self-contained and requires minimal teacher preparation. The philosophy of this series is based on an experience-oriented process that encourages self-paced independent student work. This particular unit, designed for the primary grades, is an introduction to ecology. Using plants that are easily grown in the classroom, students learn about the environmental factors, such as light, water, and soil, that affect plant growth. Through the activities included in this unit, students experiment with controlling these variables, while making observations and keeping accurate data. The plants needed for the investigation include cuttings from house plants, potatoes, bulbs, and seeds. A list of materials, directions, backgroun information, and student worksheets that can be duplicated are included for the teacher. (MA)

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THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process—in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life-styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum—to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

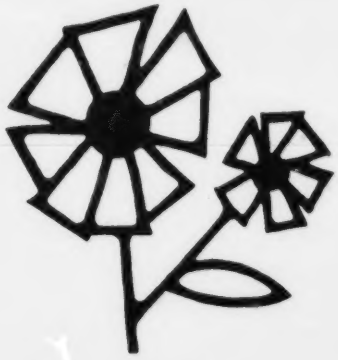
Plants in the Classroom

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.



Design and Illustrations by
JAN BLYLER

Plants are frequently grown in the classroom, and many of the plants used in this lesson will already be common classroom occupants. In this project, however, we go one step further than the usual process of growing classroom plants.

Ecology is the study of the interrelationship of living things with other living things and with non-living things. This unit is concerned with introducing ecology to children, as well as with the way in which a child approaches ecology. As the concern is twofold, so is the purpose of this lesson: (1) the class will investigate the interrelationship of their plants with the environment by discovering the required amounts of sunlight and water, room for growth, and type of soil; and (2) they will learn that they can control the variables in the plant's environment, and must do so to arrive at valid conclusions. The latter is vital to any science investigation, but could easily be unknown or ignored by children.

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INTRODUCTION

Children often see plants and plant seeds either outdoors or in the classroom. As teachers, we often tell them three things about growing plants:

1. **Plants need soil.**
2. **Plants need water.**
3. **Plants need sunlight.**

We direct the children to "put it by the window," "water it every day," etc. Often we neglect to tell them that the soil contains food for the plant in the form of minerals, that the water carries the food to the leaves, and that the sunshine converts the food into growth energy.

The following activities and experiments with plants and seeds include six distinct types of plants.

1. **A cutting from a house plant.**
2. **Carrot tops grown in water and then soil.**
3. **Sweet potatoes grown in water.**
4. **Red and white potatoes grown in soil.**
5. **Bulbs grown in pebbles.**
6. **Seeds — germinating, grown in soil, etc.**

If you simply wish to grow these six types of plants in the classroom, the children can gain a knowledge of care, growth patterns, and differences in plants.

If you also wish to have the children develop an understanding of experimentation, variables in an experiment, record-keeping, and the use of data in reaching understandings, then the unit activities will be of invaluable assistance.

The suggested records to keep for each activity are indicated in the text. Full page copies of the record sheets are furnished in the back of this unit so that you can remove them and copy them for the children.

MATERIALS

baggies
water
toothpicks
blotter paper
nut cups
pots
jars
low bowls
coffee cans, 2- and 3-lb.
toweling
soil — black, sandy, clay, commercial
red and white potatoes
large house plant — philodendron, etc.
sponges
low containers (tinfoil trays)
construction paper
large spoon
milk cartons
knives
carrot tops
ruler
sweet potatoes
string
bulbs
paper plates
pebbles
low, transparent containers
tall, transparent containers
wild bird seed
bean seeds
pea seeds
corn seeds
measuring cups

Plants in the Classroom

ACTIVITIES

I. Plant Cutting

MATERIALS

philodendron plant — soil
transparent containers — water
(e.g., jars) — string, ruler
construction paper

Keep a philodendron plant in your room until you are ready to begin this activity.

- Divide the class into small groups — perhaps classroom rows.
- Provide each group with a transparent container.
- Have a group member fill it with water.
- Have members from each group:
  a) take a cutting from the plant (be sure each group gets an end cutting),
  b) place the cutting in a transparent container,
  c) identify the container with a numeral or name.
- Have each group select a location in the room for the container, place it there, and make a clear note of it.
- Have each group keep the container well filled with water.
- Have each student watch for rooting.

ASK THE CHILDREN:

About the different ways the plants are being handled (location in room)

About the similar ways the plants are being handled (containers, amount of water, time for watering).

About the differences in the plants themselves (some cuttings are larger).

- Have each group (hopefully this idea will come from a member of the class) measure the total length of the cutting by using a piece of string and placing it on a ruler, in addition to noting the number, length, and width of the leaves. An interesting way to record this would be in picture form. Have the children carefully trace the cutting on paper and record its measurements along the side — length of the cutting; width of the leaf or leaves; length of the leaf or leaves.

PLANT CUTTING - WATER

	Now	1st wk	2nd	3rd	4th
length					
no. of leaves					
width leaves					
length leaves					
no. of roots					
length roots					

- When the roots are two or three inches long, have each group plant its cutting in soil. Make sure the containers are identical. (A peanut butter jar would be an appropriate size.)
- Use the same kind of soil for all the plantings so that you can have a controlled experiment. You may want to use black top soil from someone's yard or a "black magic" type of commercial soil.
- Plan how much water each plant will receive and how often it will be watered. Plan to water every day — enough to keep the soil moist.

You now have cuttings which are rooted similarly in the same kind and size containers, with the same soil, and plans to water the same amount each day. At this point your class is ready to conduct an experiment testing the need of sunlight.

ASK THE CHILDREN:

About the similar ways that these plants are being handled (containers, soil, watering plans).

About what is similar but not exactly the same (the plant itself).

About other needs that a plant has which we can vary and thus test (need for sunlight).

- Have each group select a location for its plant which will have a describable degree of sunlight. If a group wants to, it can place its plant in a dark place, but don't force this or any other choice which is involved. It is important that the students think up and execute their own experiments. If you want to insure that a plant growing in darkness is tested, make an extra cutting in the beginning and test this yourself. Explain the concept of scientific controls to the class.
- Have the children record information each week on their record sheets. (Copies of record sheets for duplicating are bound at the back of this booklet.)

PLANT CUTTING – SOIL

	NOW	1st WK	2nd	3rd	4th
length above soil					
no. of leaves					
width leaves					
length leaves					
length entire plant					

- Have the class plan a comparative chart and fill it in from their group records.

ASK THE CHILDREN:

About the light needs of this type of plant.

About any factors that may have influenced the results (heat, forgetting to water, etc.).

Whether they could better control an experiment and how.

- Have each group keep their plant in its location and continue to watch it grow. Continue recording as long as there is interest.

II. Carrot Tops

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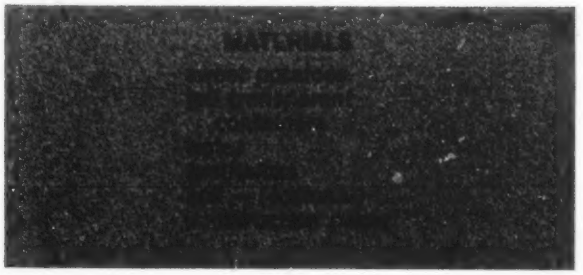
- Have children bring in carrot tops.
- Place each top in a shallow container.
- Put in enough water to come to the top of the carrot pieces.
- Permit to grow.
- Measure and record growth.

CARROT TOP GROWTH	NOW	1st WK.	2nd	3rd
height - top				
width - top				
number roots				
number shoots				
height shoots				

- When the carrot tops are about three inches tall, have them transferred to soil. Vary the soil types by trying to use at least four different kinds: sand; clay (try your school art clay); black soil (from a yard); and commercial soil.
- Keep other variables constant: same type of containers; same amount and pattern of watering; same location.
- Have each planting labeled as to group of students, soil type, etc.

III. Sweet Potatoes



- Have children bring in sweet potatoes. Be sure you have at least one potato for each group.
- Have groups place a whole sweet potato into a tall transparent container. Add water until only half of the potato is submerged. The potato can be held up by inserting toothpicks into three of its sides and resting them on the top edge of the container.

If the children wish to plant potatoes in soil or any other substance, encourage them to do so.

- Have the children place the sweet potatoes in different locations — try to vary these a great deal (i.e., one in direct sun, one in a dark closet, etc.).
- If there is difficulty in initiating the growth of the potato it may be that a growth deterrent spray was applied to the potato prior to its marketing.

SWEET POTATO GROWTH RECORDS
DATE PLANTED _____
DATE 1st ROOT APPEARED _____
DATE OF 1st SPROUT _____
DATE LONGEST SPROUT REACHED 2 INCHES _____

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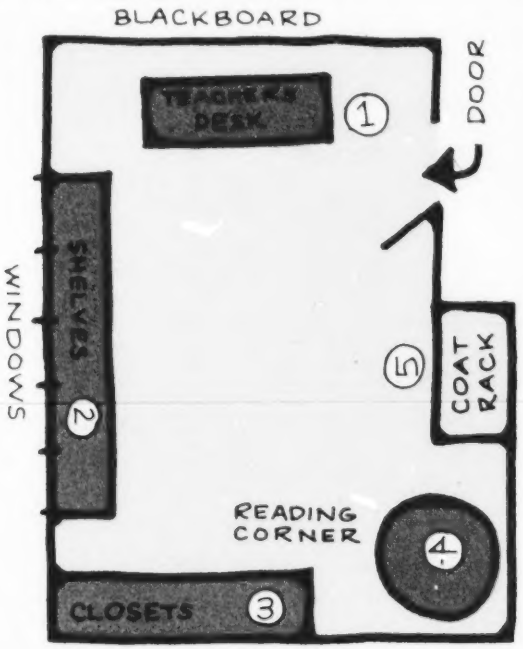
Another possibility is the fact that there are definite "spurts" and "lags" in a sweet potato's growth, and luck may be against you. Since it will be difficult to determine the reason, just begin with another sweet potato if growth will not start.

For records, have the children sketch a map of the room, numbering the locations. Then have records kept by date and sprout length.



ASK THE CHILDREN:

About the best conditions for sprouting a sweet potato.

About the best conditions for growing a sweet potato.

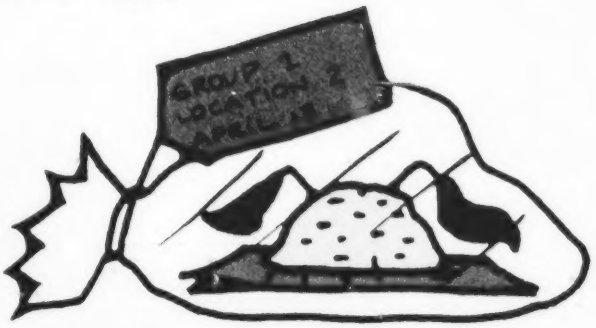
About other conditions that influence the growth.

IV. Potatoes

MATERIALS

red and white potatoes
knives
toweling
baggies
water
coffee cans — 2 lb.
many types of soil
construction paper
measuring cups

Divide the class into five groups. Each group will conduct their own experiment with the potatoes, and each group will need at least one red potato and one white one. Ask some children to bring in potatoes -- or ask each child to bring one of each kind.



Group 1 -- Moisture and Sprouting

- Cut each potato into several pieces, each piece including a few eyes.
- Place a portion of each kind of potato in the following places:
  - In a **sunny** place — on a **dry** piece of paper towel, inside a baggie.
  - In a **sunny** place -- on a **wet** piece of paper towel, inside a baggie.
  - In a **dark** place — on a **dry** piece of paper towel, inside a baggie.
  - In a **dark** place — on a **wet** piece of paper towel, inside a baggie.

Group 1 will have eight pieces of potato to study, four white and four red. If the children wish to add their own experimental conditions, be sure to encourage them to do so.

- Mark each potato piece with its location, date, and group.
- Add water to the moist pieces when necessary.

GROUP 1
POTATO SPROUTING RECORDS

DRY/RED	DATE OF SPROUTS	NO. OF SPROUTS	HEIGHT 3 WEEKS
SUN			
DARK			
WET/RED			
SUN			
DARK			
DRY/WHITE			
SUN			
DARK			
WET/WHITE			
SUN			
DARK			

Combine records at the end of the experimental period and present to the rest of the class.

ASK THE CHILDREN:

About the effect of environment on the potato sprouting.

•

Group 2 — Potato Growth and Soils

- Have the children bring in white and red potatoes.
- Have the children bring in two-pound coffee cans in which to plant the potatoes.
- Have the children cut their potatoes into several pieces — as many pieces as there are coffee cans. They may, of course, plant a whole potato in a can. In fact, this is a good opportunity to make many varied tests, for potatoes and coffee cans should be plentiful.
- Have the children plant the pieces from both potatoes in at least four soil types (sand, clay, black dirt, and commercial soil), eight plantings in all.
- Make sure the children keep the sunlight and watering the same.
- Have the children check for first sprouting, height of plant, and general growth pattern.

Growth record sheets appear in the back of the book. Display these records near the growing potatoes so that the whole class can watch this experiment and discuss it later. When the records have been completed, discuss the following with the children.

ASK THE CHILDREN:

About the soil in which potatoes sprout first.

About the kind of soil in which they grow the largest.

About height vs. thickness in respect to largeness.

GROUP 2 POTATO GROWTH RECORDS

AMOUNT OF WATER FREQUENCY WATERED LOCATION

Red	Date Planted	Date 1st Sprout	2nd WK.			3rd WK.			4th WK		
			Ht.	leaves	Sprouts	Ht.	leaves	Sprouts	Ht.	leaves	Sprouts
sand											
clay											
black											
comm.											
White											
sand											
clay											
black											
comm.											

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Group 3	WATER TEST FOR POTATO GROWTH									
	Date	2nd WK			3rd WK			4th WK		
		Ht.	Sprouts	leaves	Ht.	Sprouts	leaves	Ht.	Sprouts	leaves
Red Potatoes										
1/4 CUP										
1/2 CUP										
1 CUP										
2 CUPS										
White Potatoes										
1/4 CUP										
1/2 CUP										
1 CUP										
2 CUPS										

Group 3 — Water Needs for Potato Growth

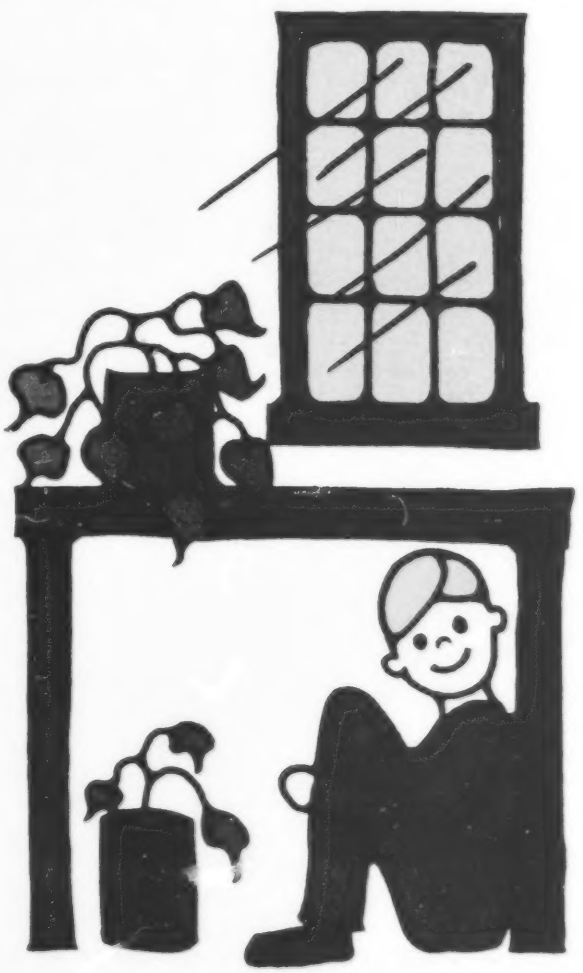
- In two-pound coffee cans, plant pieces of red and white potatoes in the same kind of soil. Let the group select the type of soil it wishes to use
- Vary only the water. Let the students decide how many different amounts of water they will check. Since they are using two-pound coffee cans, they might use ¼ cup per day, ½ cup per day, 1 cup per day and two cups per day.

ASK THE CHILDREN:

About the amount of water needed for the best growth.

Why the potatoes were all planted in the same size containers.

About the "constants" of this experiment.



GROUP 4	SUNLIGHT NEEDS FOR POTATO GROWTH									
		1st WK			2nd WK			3rd WK		
	Date	Ht.	Sprouts	leaves	Ht.	Sprouts	leaves	Ht.	Sprouts	leaves
Red Potatoes										
Sunny										
Middle										
Dark										
White Potatoes										
Sunny										
Middle										
Dark										

Group 4 — Sunlight Needs for Potato Growth

- Have children bring in a red and a white potato, and at least six coffee cans.
- Select the type of soil you want to use for each piece (probably black soil).
- Cut each potato into three pieces and plant in the coffee cans.
- You are going to test sunlight needs for growing potatoes so you will keep the other variables constant: container size, soil, amount of water, and frequency of watering.
- To check the sunlight needs, have one of each kind of potato in the sunniest spot in the room, another in the center of the room, and a third (both red and white) at the far side of the room, away from windows.

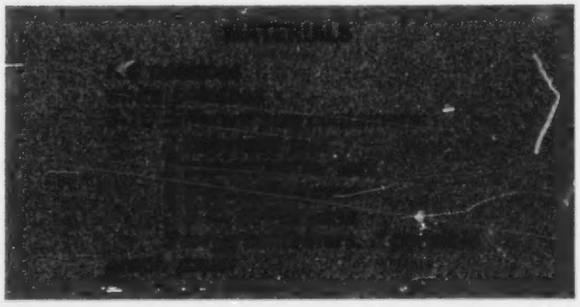
ASK THE CHILDREN:

About sunlight needs.

If this test is complete enough to really determine sunlight needs.

About other light conditions that could be tested.

Group 5 — Container Size and Growth of Potatoes



- Cut each potato into several pieces. Since you are testing for the influence of container size on final potato growth, keep other variables the same — soil, sunlight, frequency of watering. However, adjust the amount of water to the size of the container, making sure to keep the soil equally moist in all of the containers.
- Record growth and display for class use.

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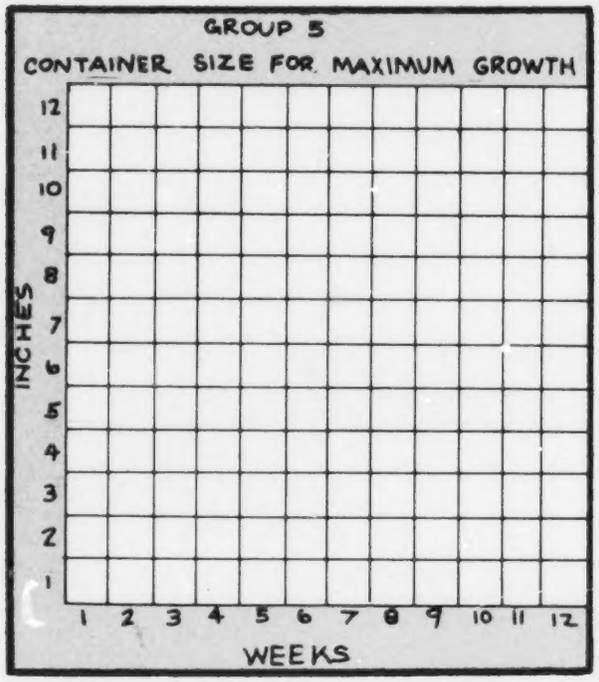
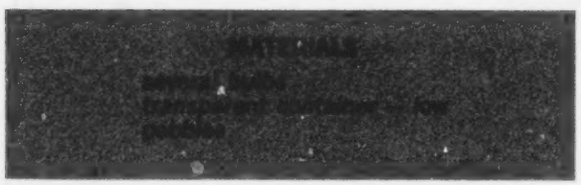
- Graph the growth patterns as follows:
  babyfood jar .....
  peanut butter jar .....
  2-lb. coffee can xxxxx
  3-lb. coffee can ooooo
  larger + + +



The rest of the activities in this unit can be planned by the children. It is a good idea to have each child work individually, for this will enable his activities to provide a basis for evaluation of his understandings.

1. Does the child develop a "valid" test?
2. Does the child test only one condition at a time?
3. Does he control other variables?
4. Is the child able to cope with all the variables or does he need assistance?
5. Does he develop a clear set of records?

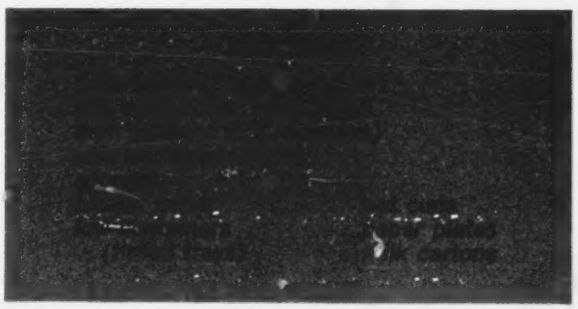
V. Bulbs



Bulbs can be planted by the entire class.

- Use them to decorate the room and to inform the children of yet another form of plant growth.
- To grow them, follow the planting directions which accompany the bulbs.
- Encourage any children who wish to make growth tests and record the results.

VI. Seeds



Lay a quart or half-gallon milk carton on its side and cut off the top side — if necessary, tape the opening closed and you have a fine planter. If you want to make the planters very attractive, you can paint the outside with tempera paint mixed with liquid soap instead of water.

A. Seed germination

- Divide the class into three groups. Each group will use one kind of seed.
- Have each member in the group set up seed germination conditions that are different from the others in his group. Have the children consider the following conditions:
  moisture
  sunlight
  covering for container
  temperature (keep refrigerated, etc.)
- Have each group devise a recording format that will be easy to use and easy to understand.

B. Wild bird seed

- Give each child ½ nut cup of bird seed.
- Give each child a paper plate.
- Have the children spill the seed out onto the paper plate.
- Have them examine the seeds (sort, count, etc.).

There are broad ranges of activities possible with these seeds. Some are:

1. Find out what kind of a plant each type of seed will become.
2. Find out the best soil for one of the seed types.
3. Find out the sunlight needs of one of the seed types.
4. Find out the water requirements of one of the seed types.
5. Find out the growth pattern of one of the seed types.
6. Find out how tall the plant of one seed type can grow in six weeks.
7. Find out which kind of seed would grow best when several are planted together.

EXTENDED ACTIVITIES

1. Collect mosses and liverworts from logs, soil, or trees, and determine the care necessary to keep them alive and growing.
2. Grow mold on bread in various conditions: considering sunlight, dark, water, air, container, etc. Determine the environmental needs for mold growth.
3. Set up a mold garden or two with bread, cereals, fruit and vegetables, in a clear plastic hat or sweater box. If you set up only one, be sure to keep it well moistened; for several, vary the moisture.
4. Examine science textbooks in your school for interesting experiments, e.g., extracting green from leaves by using alcohol, or testing for starch in leaves.

Name _____

PLANT CUTTING

Record When in Water

	Beginning	End Week 1	End Week 2	End Week 3	End Week 4
1. Length of cutting					
2. Number of leaves					
3. Width of leaves					
4. Length of leaves					
5. Number of roots developed					
6. Length of roots developed					

Name _____

PLANT CUTTING

Record When in Soil

	Initial	End Wk. 1	End Wk. 2	End Wk. 3	End Wk. 4
1. Location of plant (next to window, under table, etc.)					
2. Length of cutting above soil					
3. Number of leaves					
4. Width of leaves					
5. Length of leaves					
6. Length of entire plant from top of leaf to end of longest root (optional since the plant will have to be removed from the soil and replanted)					

Name _____

CARROT TOP GROWTH				
	Initial	End Week 1	End Week 2	End Week 3
Height of Top				
Width of Top				
Number of Roots				
Number of Shoots				
Height of Shoots				
Date put in Soil				

Name _____

Group 1. POTATO SPROUTING RECORD SHEET

DRY RED	Date of Sprouting	Amount of Sprout	Sprout in three wks.
Sunlight			
Darkness			
MOIST RED			
Sunlight			
Darkness			
DRY WHITE			
Sunlight			
Darkness			
MOIST WHITE			
Sunlight			
Darkness			

Name _____

Group 2

POTATO GROWTH RECORDS

Amount of Water _____ Frequency of Water _____ Location in Room _____

RED POTATOES	Date of Planting	Date of First Sprout	Second Week			Third Week			Fourth Week		
			Ht.	No. Sprouts	No. Leaves	Ht.	No. Sprouts	No. Leaves	Ht.	No. Sprouts	No. Leaves
in sand											
in clay											
in black soil											
in commercial soil											
WHITE POTATOES											
in sand											
in clay											
in black soil											
in commercial soil											

Name _____

Group 3 WATER TEST FOR POTATO GROWTH

RED POTATOES	Sprouting Date	Second Week			Third Week			Fourth Week		
		Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves
¼ C.										
½ C.										
1 C.										
2 C.										
WHITE POTATOES										
¼ C.										
½ C.										
1 C.										
2 C.										

Name _____

Group 4 SUNLIGHT NEEDS FOR POTATO GROWTH

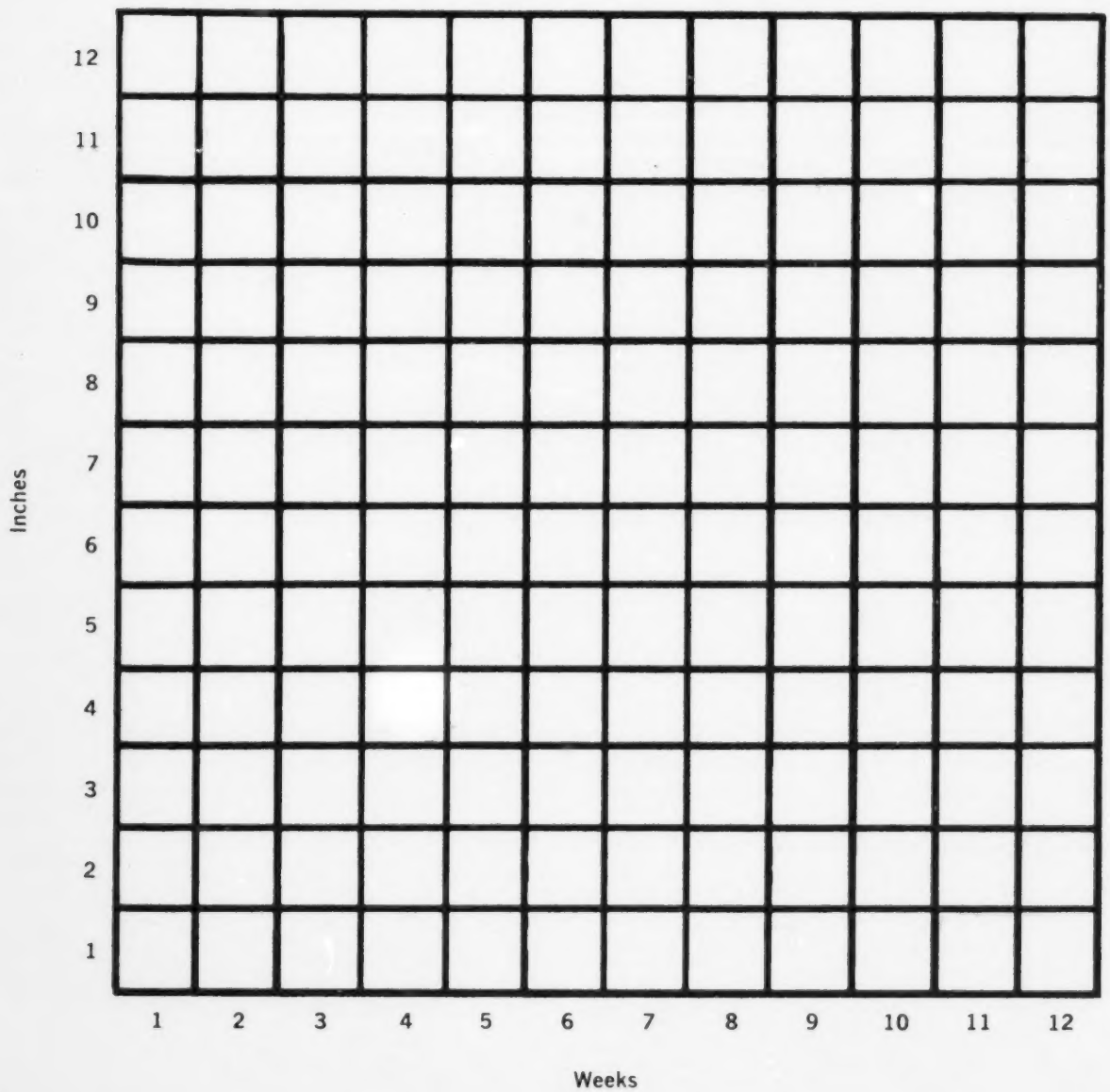
RED POTATOES	Sprouting Date	End First Week			End Second Week			End Third Week		
		Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves	Height	No. Sprouts	No. Leaves
Sunny										
Middle										
Shady										
WHITE POTATOES										
Sunny										
Middle										
Shady										

Graph the growth patterns as follows:

babyfood jar	.....
peanut butter jar	.....
2 lb. coffee can	xxxxx
3 lb. coffee can	ooooo
larger	+ + +

Name _____

CONTAINER SIZE AND MAXIMUM GROWTH OF POTATOES



THE ENVIRONMENTAL UNITS

Below is a list of the twenty-four titles in the Environmental Discovery Series. Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels and subject areas depending upon the interests and abilities of the students.

Order No.	Title	Grade Level	Price	Order No.	Title	Grade Level	Price
79007	Plants in the Classroom	3-6	$1.50	79123	Genetic Variation	4-9	$1.50
79016	Vacant Lot Studies	5-9	1.50	79132	Soil	2-9	1.50
79025	Differences in Living Things	4-8	1.00	79141	Tile Patterns and Graphs	1-2	1.00
79034	Shadows	1-8	1.00	79150	Plant Puzzles	1-6	1.50
79043	Wind	3-6	1.50	79169	Brine Shrimp and Their Habitat	1-5	1.50
79052	Snow and Ice	1-6	1.50	79178	Nature's Part in Art	3-6	1.50
79061	Man's Habitat—The City	4-9	1.50	79212	Contour Mapping	4-9	1.50
79070	Fish and Water Temperature	4-9	1.50	79187	Change in a Small Ecosystem	5-9	1.50
79089	Oaks, Acorns, Climate and Squirrels	1-6	1.50	79196	Transect Studies	3-9	1.50
79105	Nature Hunt Spec. Ed.	K-1	1.00	79203	Stream Profiles	4-9	1.00
79098	Sampling Button Populations	3-9	1.00	79221	Color and Change	K-2	1.00
79114	The Rise and Fall of a Yeast Community	6-9	1.00	79230	Outdoor Fun for Students	1-12	1.50

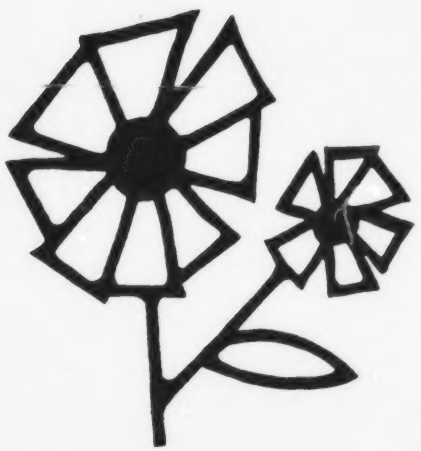
If you would like a free brochure describing activities in the individual units, write:

The National Wildlife Federation
Educational Servicing
1412 16th Street, N.W.
Washington, D. C. 20036

Written and developed by:

NWF
John Cary Stone
James D. Davis
Wendy Kay
Phil Nicholson
Tom L. Smith

MESF
Edmund Bray
Barbara Clark
Robert Collins
Joann Current
John Heitkamp
David Jones
Karen Jostad
Edward Landin
Richard Myshak
Michael Naylon
Robert O'Hara
Noreen Teachout
Carl Vogt



NATIONAL WILDLIFE FEDERATION
1412 Sixteenth Street, N.W.
Washington, D.C. 20036